

# DAILY LIFE IN A MISSION

**NEED  
TO  
KNOW**

## Teacher Information: Using Natural Dyes

**Background:** *Long before the Spaniards arrived in North America, the indigenous people had used many plants and mineral materials as dyes and stains. Some of the earliest cave paintings were made with natural dyes. The paintings derived from mineral stains have retained the greater color. The ones that have faded to “ghost paintings” (barely visible) are believed to have been made from organic materials.*

*From the late sixteenth through the mid-nineteenth centuries, both Spaniards and Native Americans experimented with native plants to produce dyes that could be used on the wool of Spanish sheep. One of the most notable dyes was cochineal. This red dye is made from the bodies of small insects (*Dactylopeas coccus*) that feed on prickly pear (*Opuntia* species). The insect can be scraped from the prickly pear pad; and then by pressing the insect firmly against the side of a dye pot, the dye is released.*

*The Aztecs collected tribute (payment) from tribes they conquered. Cochineal was part of this payment. As red dye had been difficult to produce, Spain continued this tribute system and exported the dye to Europe. (Among other things, the dye was used to make red fabric for British soldiers’ jackets in the 18<sup>th</sup> and 19<sup>th</sup> centuries.) European fabric found its way back to the Americas where it was unraveled and rewoven by the Navajo to make blankets. Blankets containing this wool are now very rare and valuable.*

*Pigments cause the color in plants. Pigments can work alone or in combinations to produce color. Chlorophyll is the pigment that is responsible for the green color in plants. It allows the plant to produce sugar for plant growth in a process called photosynthesis. Chlorophyll is relatively insoluble in water, but by soaking plants in alcohol for a few days, the chlorophyll can be safely extracted. This technique provides the best green color.*

*Tannic acid, derived from oak, sumac, tea, and coffee, is responsible for many brown colors. Tannic acid is a strong dye that can be used as a mordant to “fix” or set the dyes. It is used in tanning leather and making inks, also.*

*Carotenoids are a fat-soluble pigment that produces yellow and reddish orange colors seen in autumn leaves. The red colors are a result of zanthocyanins, which are partly water-soluble.*

*Beta-cyanin in beets produces red and purple colors. Indigotin is responsible for the bright blue of indigo brought to the Americas by the Spaniards.*

*Mission Indian women primarily used cochineal and indigo to dye yarns for weaving. Weaving was considered a career for men in European cultures. Much of the mission’s colorful material was imported from Mexico.*

## TEKS(Texas education standards)

- *Demonstrate safe practices during field and laboratory investigations.*

- *Plan and implement a descriptive investigation including asking well-defined questions, formulating testable hypothesis and selecting and using equipment and technology.*
- *Collect information by observing and measuring.*
- *Construct simple graphs, tables, maps, and charts to organize, examine, and evaluate information.*
- *Demonstrate that repeated investigations may increase the reliability of results.*
- *Describe ways people have adapted to and modified their environment in Texas, past and present.*
- *Identify reasons why people have adapted to and modified their environment in Texas, past and present, such as the use of natural resources to meet basic needs.*
- *Analyze the consequences of human modification of the environment in Texas, past and present*

## **Materials**

- *Stirring stick or spoon*
- *Plant material (wide variety; a large amount of each will be needed)*
- *Beaker, Pyrex*
- *Bunsen burner, hot plate or other heat source*
- *Water*
- *Vinegar*
- *Measuring spoons*
- *One fabric square per student, 4" X 4", 100% cotton (washed to remove sizing.)*
- *Tongs*
- *Beaker, plastic acceptable, or a large plastic jug*
- *Cheesecloth or pantyhose*
- *Yarn, white cotton*
- *Potholders*
- *Plastic gloves*
- *Goggles*
- *Apron(s)*
- *Chart: Dyes from Plants*
- *A Field Guide of Flora (for teacher)*

## **Teaching Hints and Safety Precautions**

1. *If you use a plant material that is not listed, be sure it is not poisonous.*
2. *Wear plastic gloves and goggles, and keep hair tied back. Heat and potentially hazardous materials can injure.*
3. *Wear aprons and short-sleeved clothing. Dyes will stain. Heat is involved.*
4. *If using cochineal, burn the spines from prickly pear before removing cochineal.*
5. *Have students work in a group of three or four to prepare or use the dyes.*
6. *Avoid eating or drinking in a science laboratory.*
7. *Wash your hands after the investigation.*
8. *Place a blank "Chart I" on the chalkboard for students to share their data with the class.*

9. *Use as much variety of plant materials as possible so comparisons can be made. See the chart, Dyes from Plants, for ideas.*  
*Other possible choices:*  
*Frozen or canned berries: allow them to thaw and press out the juice*  
*Canned beets: strain the liquid.*
10. *Dyes may be refrigerated or frozen for future use.*
11. *Do not add food color to the dyes. Use more plant material and less water to make the color darker. Rusty nails may make the color more vibrant.*
12. *Use distilled water. Minerals in tap water may alter the dye color.*
13. *Remind students that park ethics do not allow collection or removal of plant material from national, state, county, and city parks.*

## **References**

*Brown, Rachel. The Weaving, Spinning and Dyeing Book. New York, NY: Alfred A. Knopf Publishing. 1978.*

*Carison, Laurie. Eco Art! Charlotte, VT: Williamson Publishing Co. 1993.*

*Forte, Imogene, and Frank, Marjorie. Puddles and Wings and Grapevine Swings. Nashville, TN: Incentive Publications, Inc. 1982.*

*Kohl, Mary Ann F. and Gainer, Cindy. Good Earth Art. Bellingham, WA: Bright Ring Publishing. 1991.*

*Tull, Delena. A Practical Guide to Edible and Useful Plants. Austin TX: Texas Monthly Press. 1987.*

[www.straw.com/sig/dyehist.html](http://www.straw.com/sig/dyehist.html)

# DAILY LIFE IN A MISSION



## Student Information: Using Natural Dyes

**Objectives:** You will be able to produce a natural dye from plant material, similar to how mission Indians did.

### Engagement

Have you ever slid down on grass? What happened to your pants? Plants can produce substances that change the color of fabrics. Plan with your teacher an investigation about producing a natural dye bath from plant materials. Include in your plans:

1. A hypothesis about how to achieve the color you want.
2. A list of questions you want to answer with your investigation.
3. A list of plants you want to obtain for a variety of colors.
4. A list of materials needed to complete your investigation.



### Exploration

In this activity, you will investigate various plant materials as natural dyes.

Obtain Chart I from your teacher.

1. Record the name of a plant, the color of the plant, and your hypothesis about the color of dye that it will produce.
2. Cut or tear the plant material into small pieces and place it in the Pyrex beaker.
3. Add just enough water to cover the material. This is the dye bath.
4. Boil for 5-20 minutes until the water reaches the color intensity you want.
5. Cool the dye bath until it is safe to handle.
6. Strain the dye bath through a piece of pantyhose into another container.
7. Add a tablespoon of vinegar to act as a mordant. Mordants set or keep the color in the cloth.
8. Clean the original beaker and return the dye to the beaker.
9. Reheat the dye bath in the beaker.

10. Dip a strand of white yarn into the dye to check the color. The longer it stays in the dye bath, the deeper the color.
11. When you like the color, place your fabric square into the dye and simmer until it reaches the color you want. Be sure to stir occasionally.
12. Remove the cloth from the dye, and rinse with fresh cool water until the rinse water is clear.
13. Spread out the cloth to dry.
14. Record actual color of the dye you obtained on Chart I.
15. Transfer your group's data to the class' Chart I on the chalkboard.
16. Copy the data other groups obtained to your Chart I.

### Explanation

1. What happened to the color of the dye as the dye bath was heated?
2. Using the class' data, what did you observe about the color of the plant material and the color of the dye it produced on the yarn and cloth?
3. Were there exceptions to the observation you made in question #2?
4. Obtain the chart, *Dyes from Plants*, from your teacher. Compare your observations with what is on the chart.
5. Were there exceptions to the observations made in question #2 on the chart?
6. If you found any exceptions, can you think of an explanation for the exception?
7. Do you feel more confident about your answers if you have the class' data and the data of the people who made the dye chart? Why?
8. Add to the chart any plants you discovered as a source for dyes.

### Elaboration

Visit Mission Espada. Take your chart,



*Dyes from Plants*, and a local plant field guide. Put a check mark by any plant you see at the mission that could have been used by the Native Americans for dyes. Add other names of plants that you see that you would want to try for a dye. (Remember. No plant material can be picked or removed.)

## **Evaluation**

Create a Quilt Block Bulletin Board using the fabrics that you and your classmates dyed. Add illustrations and names of the plants that were used to produce the dyes.

Alternative: Hard-boiled eggs can be dyed instead of cloth. Wrap the hard-boiled egg in a piece of cloth.

1. Cut thin strips of cloth and tie them securely around the egg in several places.
2. Dip the eggs in a natural dye.
3. Leave the eggs inside the tied cloth to "drip dry" for several hours or overnight.
4. Unwrap the eggs and use them to make a display; add illustrations and names of the plants that were used to make the dyes to the display.

## **Evaluation Criteria**

40%

You participated in creating a neat and attractive Quilt Block Bulletin Board or Colored Egg Display

You accurately illustrated the plants that produced the dyes

60%

You answered all questions and completed charts with answers based on observations made in the investigations

You completed your observations at Mission Espada about plants

**Chart I**

<b>Group</b>	<b>Plant material</b>	<b>Color of plant material</b>	<b>Hypothesis: Dye Color</b>	<b>Actual Dye Color</b>
<b>1</b>				
<b>2</b>				
<b>3</b>				
<b>4</b>				
<b>5</b>				
<b>6</b>				
<b>7</b>				

## DYES FROM PLANTS

<u>Dyes</u>	<u>Dyes we discovered</u>
	<u>Yellow</u>
Onion (skins)	
Peach (tree bark)	
Tomato (vines)	
Willow (leaves)	
Daffodil (petals)	
Pomegranate (rinds)	
Marigold (blossoms)	
Orange (rinds)	
Agarita (roots)	
	<u>Red</u>
Cranberry (fruit)	
Cherry (fruit)	
Prickly pear (fruit)	
Beets (leaves and roots)	
Cochineal (insect)	
	<u>Orange</u>
Tomato (fruit)	
	<u>Green</u>
Grass	
Spinach	
Carrot (tops)	
Parsley (leaves, fresh)	
Tomato (fruit)	

<u>Dyes</u>	<u>Dyes we discovered</u>
	<u>Blue and Purple</u>
Blueberry (fruit)	
Blackberry (fruit)	
Red Cabbage	
Sunflower (seeds)	
Larkspur (flowers)	
Dandelion (roots)	
Prickly pear (fruit)	
Grapefruit (meat)	
	<u>Tan and Brown</u>
Pecan (hulls)	
Coffee (beans)	
Tea (leaves)	
Onion (skins, red)	
Walnut (hulls)	
Madder (roots)	

**Other plants I would like to try:**